A SKETCH

OF THE

Discovery of Vaccination

AND OF THE

EVIDENCES OF ITS POWER.

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BY

JAMES W. MILLER, M.D. EDIN.,

CONSULTING PHYSICIAN, DUNDEE ROYAL INFIRMARY;

EXAMINER IN MEDICINE, UNIVERSITY OF ABERDEEN.

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PREFACE.

THE following sketch of the history of the discovery of Vaccination, and of the evidences of its power, formed the subject-matter of a lecture delivered to a local non-medical society, and since its delivery various considerations have occurred to the author which appear to him to render its publication desirable.

Without question there is among the general public a great want of information on this topic; and it could hardly be otherwise, considering how much a matter of routine Vaccination has become, and that the literature of the subject does not come in ordinary course under the notice of any but medical men. And therein lies the chief inducement for publication, because it is only this prevailing ignorance which affords a field for the spread of the dangerous doctrines of the opponents of Vaccination—doctrines which, if by any possibility they led to the accomplishment of their main purpose,—the repeal of the Compulsory Vaccination Act,—would, according to all the evidence we possess, result in a renewal of the terrible experiences which our forefathers suffered from that loathsome pestilence, Small-Pox. Considering the persistent, though misguided, energy with which these fallacious opinions are being propagated, it becomes a duty incumbent on those who know the facts of the case, for the welfare of the community to embrace any opportunity which offers, to diffuse sound information,

and so to occupy, as it were, the neutral ground, with the object of rendering it, if possible, more secure against these attacks.

Nothing is here advanced which has not been long known to members of the medical profession, and the essay is not therefore intended for them. Its sole purpose is to present, in as clear and concise a form as possible, the grounds upon which Vaccination stands, so that the argument may be easily understood by the non-medical reader.

The fallacious objections to Vaccination, as being a source of innumerable evils, are not here entered upon. These have already been ably refuted in Mr Ernest Hart's excellent pamphlet, "The Truth about Vaccination."

THE DISCOVERY OF VACCINATION AND EVIDENCES OF ITS POWER.

A SHORT reference to the history of Small-Pox as it prevailed in by-gone times, before its terrible ravages were checked by Jenner's great discovery, will form a fitting introduction to the immediate subject of this paper. Its prevalence has been, during the last half-century, so relatively small when compared with that of the other infectious diseases which every year send so many thousands to a premature grave, that it is no marvel that the people of the present generation have well-nigh forgotten its horrors, and thus have very naturally a most inadequate estimation of the priceless boon conferred upon them by the safe and simple operation of Vaccination.

Small-Pox as it existed before the Discovery of Vaccination.

Small-Pox is a disease of great antiquity, and it has even been argued on plausible grounds that the plague in Egypt of boils and blains was no other than this. Although there is evidence that it existed in China and Hindostan 1100 years B.C., its first appearance in Europe, according to authentic records, was in the year 581 A.D. It is also described in comparatively clear terms, as existing in the year 900, by Rhazes, an Arabian physician; and during the Crusades it was the cause of terrible fatality. It seems to have first invaded England early in the ninth century; and in 1527 it was carried across the Atlantic to Mexico, where it produced fearful havoc, the deaths counting by millions; and thence it spread throughout America. Curschmann mentions a curious proverb of the Middle

Ages, "From Small-Pox and love but few remain free," from which may be inferred the constant and wide-spread prevalence of the malady. Coming to more recent times, the annual mortality from Small-Pox in Great Britain, before Jenner's discovery, has been calculated at not less than 35,000, and in France at 85,685; and it was proportionally large in other countries in Europe and in America.[1] Dr Lettsom's calculation for England was 3000 for every million of the population; and if the disease prevailed in our day in the same proportion, the increase of population would yield a mortality from this cause alone of 70,000 every year,[2] exceeding the mortality in 1878, caused by all our infectious diseases put together, namely,—Small-Pox, Scarlet Fever, Measles, Diphtheria, Hooping Cough, Typhus, Enteric, and Simple Continued Fever.[3] It has been ascertained from authentic documents that 1 in 14 of all that were born died of Small-Pox.[4] In 1720, the deaths in Paris from this disease alone amounted to 20,000;[5] in Prussia, in 1796, with a population of 7,000,000, they were close on 27,000;[6] while the total mortality in Europe has been estimated at half-a-million every year.[7]

It has been argued by the opponents of Vaccination that the great diminution of Small-Pox at the present time has resulted from natural causes, aided by improved sanitary habits, but one instance alone of recent date is sufficient to shew that when the disease invades a population unprotected by Vaccination, it has lost none of its old malignity. This example is given by Mr Ernest Hart,[8] and is to the following effect:—Mr Ashbury, M.P., having in a yachting cruise visited the town of Ceara, in the Brazils, learned that Small-Pox had been shortly before extensively epidemic, and

[1] "Encyclop. Britann." [2] Hart, "Truth about Vacc.," p. 7.

[3] The figures for the ten years ending with 1878 were—71,476, 75,216, 79,661, 69,524, 48,607, 66,996, 58,350, 53,725, 51,855, and 60,162. Among these the number of deaths from Small-Pox was—1,565, 2,620, 23,126, 19,094, 2,364, 2,162, 950, 2,408, 4,278, and 1,856.

[4] Baron's "Life of Jenner," Vol. I., p. 257.

[5] Copland's "Dict. of Med."

[6] Curschmann, Ziemssen's "Cycl. of Med.," Vol. II., p. 324.

[7] Hart, *op. cit.*, p. 6. [8] *Op. cit.*, p. 4.

he ascertained that in one cemetery alone the burials of persons dead of Small-Pox, from August 1878 to June 1879, less than a year, had amounted to 27,064; the number for one of these months being no fewer than 14,375, and on one single day being as high as 812. He did not obtain the official returns for the other cemetery, but was informed on good authority that the burials there during the same period were about 13,000. Thus out of a population not exceeding 70,000, no fewer than 40,000 deaths had occurred in this one short epidemic.

This disease spared no rank of life, the palace was as open to its attack as the hut of the peasant. On this feature of the disease Mr Hart writes: "For a striking and suggestive illustration of the disease, it may be enough to point to what it did in royal families. In the family of William the Third for example, his father and mother died of it, his wife, his uncle, the Duke of Gloucester, and his cousins, the eldest son and the youngest daughter of James the Second. He himself (like his friend Bentinck) had suffered from it most severely, barely surviving, with a constitution damaged for life. Or again, in the Court of Austria, 'Joseph the First was carried off when not more than thirty-three years of age by the Small-Pox: to which, in the course of the eighteenth century, besides him, two empresses, six archdukes and archduchesses, an Elector of Saxony, and the last Elector of Bavaria fell victims.' To this list might be added many other names; among them, for instance, a dauphin (1711) and a king (1774) of France, a queen (1741) of Sweden, and an emperor (1727) of Russia. It would be thought a terror-striking epidemic now-a-days that should slay like this in high places."[1]

Another aspect of the question must not be omitted, the proportion of deaths amongst those attacked, which was much greater than is generally known by the non-medical public. To look at it by comparison, for instance, the mortality in Typhus, Enteric, or Scarlet Fever is rarely higher than 1 in 6 or 8, and frequently

[1] Hart, *op. cit.*, p. 7.

it is much lower; whereas in natural Small-Pox a very ordinary mortality was 1 in 4, and often it was 1 in 2, or occasionally even as high as two deaths for one recovery.

This is a gloomy picture, but there is yet more behind, for not only were the sufferings great of those who recovered, but a very large proportion of those, though escaping indeed with their lives, yet bore for the remainder of their days the marks of the ordeal through which they had passed. The effects were most calamitous; total blindness in many cases, as was proved by the records of the Institution for the Relief of the Indigent Blind, from which it appeared that no less than three-fourths of the applicants had lost their sight from this cause; in others, more or less complete deafness, various degrees of deformity from destruction of features or joints, or the initiation of some chronic disease which sooner or later ended in death.

Another formidable characteristic of Small-Pox was that its ravages went on from year to year without intermission; and these preliminary remarks cannot be more fitly concluded than by following the example of Mr Hart in quoting the eloquent words of Macaulay which occur in the course of his narration of the death of Queen Mary from Small Pox in 1694. "That disease, over which science has since achieved a succession of glorious and beneficent victories, was then the most terrible of all the ministers of death. The havoc of the plague had been far more rapid, but the plague had visited our shores only once or twice within living memory; and the Small-Pox was always present, filling the churchyards with corpses, tormenting with constant fears all whom it had not yet stricken, leaving on those whose lives it spared the hideous traces of its power, turning the babe into a changeling at which the mother shuddered, and making the eyes and cheeks of the betrothed maiden objects of horror to the lover."[1]

It will be evident from what has been said what our condition would be, were this fell disease permitted again to assert its strength; and it will be the en-

[1] "History of England," Vol. IV., p. 530.

deavour of the author to bring forward in this paper a selection from the immense mass of evidence which exists, such as can scarcely fail to convince the reader that the only barrier against this calamity is the protection which Jenner has put in our power.

Inoculation.

The first attempt on the part of man to combat this malignant enemy of the human race was the introduction of Inoculation. This operation consisted in introducing into one or more punctures in the skin of a healthy subject a minute portion of the matter taken from a patient ill of Small-Pox. It is a very remarkable but well established fact, and one of which there is not yet a satisfactory explanation, that when the poison was thus artificially introduced through the skin, the resulting disease was, with few exceptions, of a mild character, so that protection was secured against a future possibly malignant attack by a process which exposed the patient to a very slight danger. Ages before this practice was introduced into Europe it had been in use in various countries, in Georgia and Circassia, in Nubia, in China, and by the Brahmins in India. It is said to have existed in South Wales "as far back as tradition would reach," and also for a long time in the Highlands of Scotland, by tying round the wrists of children some worsted threads moistened with Small-Pox matter.[1] From the Eastern countries referred to the practice spread to Turkey, where Lady Mary Wortley Montague became acquainted with it, and was so impressed with its efficacy and safety that she had the courage to submit her son to the operation. This occurred in 1717. Her description of the practice, which she gives in a letter dated from Adrianople to a friend in England, is so interesting and amusing as to require no apology for being quoted in full. She writes—

"*A propos* of distempers, I am going to tell you a thing that will make you wish yourself here. The Small-Pox, so fatal, and so general amongst us, is here entirely harmless,

[1] Seaton, "Handbook of Vacc.," p. 193.

by the invention of *ingrafting*, which is the term they give it. There is a set of old women, who make it their business to perform the operation every autumn, in the month of September, when the great heat is abated. People send to one another to know if any of their family has a mind to have the Small-Pox: they make parties for this purpose, and when they are met (commonly fifteen or sixteen together) the old woman comes with a nut shell full of the matter of the best sort of Small-Pox, and asks what veins you please to have opened. She immediately rips open that you offer to her, with a large needle (which gives you no more pain than a common scratch) and puts into the vein as much matter as can lie upon the head of her needle, and after that, binds up the little wound with a hollow bit of shell; and in this manner opens four or five veins. The Grecians have commonly the superstition of opening one in the middle of the forehead, one in each arm, and one on the breast, to mark the sign of the cross; but this has a very ill effect, all these wounds leaving little scars, and is not done by those that are not superstitious, who choose to have them in the legs, or that part of the arm that is concealed. The children or young patients play together all the rest of the day, and are in perfect health to the eighth. Then the fever begins to seize them, and they keep their beds two days, very seldom three. They have very rarely above twenty or thirty in their faces, which never mark, and in eight days' time they are as well as before their illness. Where they are wounded, there remain running sores during the distemper, which I don't doubt is a great relief to it. Every year thousands undergo this operation; and the French Ambassador says pleasantly, that they take the Small-Pox here by way of diversion, as they take the waters in other countries. There is no example of any one that has died in it; and you may believe I am well satisfied of the safety of this experiment, since I intend to try it on my dear little son."

Lady Mary was a lady of great wit, and would appear, by her letters, to have loved to indulge in a little gentle raillery, so the doctors do not escape. She goes on to say—

"I am patriot enough to take pains to bring this useful invention into fashion in England, and I should not fail to write some of our doctors very particularly about it, if I knew any one of them that I thought had virtue enough to destroy such

a considerable branch of their revenue for the good of mankind. But that distemper is too beneficial to them, not to expose to all their resentment the hardy wight that should undertake to put an end to it. Perhaps, if I live to return, I may, however, have courage to war with them. Upon this occasion, admire the heroism in the heart of—Your friend, &c., &c."

Had it been her ladyship's lot to have lived in the days of Jenner, and to have witnessed his zeal and that of his medical friends to annihilate this "considerable branch of their revenue," she would doubtless have made due amends to them for her humorous banter.

Although the operation had been announced in England in 1714, it had made no progress; but after her return home, Lady Mary had her daughter inoculated; and shortly thereafter six condemned prisoners in Newgate were experimented upon. Such a liberty with prisoners would, in our philanthropic age, have certainly given birth to some Convict Protection Association. In 1722 the daughter of the Princess of Wales was inoculated; but the practice did not become general, and by 1740 had almost fallen into disuse. In 1746, however, it was revived; and the Small-Pox Hospital was founded in London, for the purpose of inoculating the poor, and keeping the inoculated patients in quarantine, which laudable practice was unfortunately afterwards departed from. The employment of inoculation now became popular, and thousands submitted to it every year. But this measure was not without serious objections. In the first place, the artificial illness was occasionally very severe, and was liable to leave permanent bad effects on the health, and moreover was not free from the risk of death, a mortality of from 2 to 5 per cent. having to be reckoned on. But its chief drawback lay in this, that the illness being true Small-Pox, it was, like it, very infectious; and every inoculated person became a centre from which the disease very frequently spread: so that the practice of inoculation had a distinct effect

in increasing the epidemic prevalence of the malady. Thus Professor Aitken states that during ninety-one years previous to the use of inoculation, epidemics occurred in a ratio equal to 71.4 for 100 years; whereas during sixty-three years in which inoculation was employed, the ratio was equal to 84 epidemics in 100 years. And in this connection it may be stated that he gives the ratio for the fifty-five years during which vaccination has been mainly practised as equal to only 24 epidemics in 100 years.[1] This serious effect of the general adoption of inoculation is further confirmed by Dr Lettsom's statement that the yearly bills of mortality show that in forty-two years before inoculation (ending 1722) the proportion of deaths from Small-Pox to the deaths from all causes was 72 to 1000, while for the same period after inoculation was in full use (1731—1772) the proportion was 89 to 1000. Thus it is apparent that although inoculation was a benefit to the individual who was exposed to the chance of having Small-Pox in its severe natural form, it was nevertheless an evil to the community. Very properly, therefore, after Vaccination was established on sure grounds, a law was passed in 1840 declaring the further employment of inoculation illegal, and subjecting offenders to imprisonment.

Discovery of Vaccination.

Jenner's great discovery was proclaimed to the world in 1798; and, curious to say, we find here another illustration of the proverb that there is nothing new under the sun. Dr Copland states that it appears from ancient Sanscrit writings that inoculation with Cow Pox matter had been practised from very early ages in India and other parts of the East, and that Mr Bruce, Consul at Bushire, found that it had been for ages known in Persia; and it is stated, on the authority of A. von Humboldt, that it had been also for a long time employed by the mountaineers of Mexico. Curschmann[2] states that in Europe, Suhrer, in 1713,

[1] "Science and Practice of Medicine," 7th edition, p. 483.
[2] Ziemssen's "Cycl. of Med."

(long before Jenner was born,) and Sutton and Fewster in England, in 1765, called attention to this property of Cow Pox, and that a school teacher named Plett, in Holstein, vaccinated three boys in 1791. He nevertheless gives Jenner all the honour of the discovery. It also appears that, in 1774, a Gloucestershire farmer, Benjamin Jesty, inoculated his wife and two sons with Cow Pox matter, in order to protect them against Small-Pox.[1] These facts were however unknown to Jenner when he was conducting his researches; he was a man of too high integrity and disinterestedness to be guilty of plagiarism.

The story of Vaccination would be incomplete without some reference to the history and character of its illustrious discoverer. Edward Jenner was born on the 17th May 1749, being the third son of Stephen Jenner, Vicar of Berkeley, who was a considerable landed proprietor. Jenner was a devoted, enthusiastic, and accomplished student of Natural History, and before he was nine years of age had manifested his tastes in this direction, having made a collection of nests of the dormouse; and during his school-days he spent much of his play-hours in searching for fossils. On the completion of his school education he became apprentice to a surgeon in Sodbury, and it was during this period that the first dawn of his great work broke upon him. One day a young woman came to his master's surgery for advice, and Small-Pox being mentioned, she at once said, "I cannot take that disease, for I have had Cow Pox;" and these words started in his mind the train of thought which soon led him to perceive the vast consequences to humanity which might be realised from this fact in nature, if it were indeed a fact. And here it may be observed that the practice of Vaccination was not, strictly speaking, an invention of the doctors. It was not the outcome of any medical reasoning upon supposed analogies between Cow Pox and Small-Pox. The protective power of Cow Pox against Small-Pox was a fact

[1] Trousseau's "Clinical Medicine," Vol. II., p. 99.

in Nature, first recognised by the ignorant peasantry, and, as we have seen, not in this country alone ; and Jenner's great merit lay in his quick perception of the vast benefits involved if the vulgar belief proved to be well founded, and in his dogged perseverance in his researches, in the face of fierce opposition and ridicule, till he triumphantly planted Vaccination on the solid rock of scientific fact, from which it will never be shaken.

Having completed his apprenticeship, Jenner went to London to prosecute his professional studies, and became a resident pupil of the great John Huuter, with whom he kept up a life-long friendship. He frequently mentioned to Hunter his belief regarding Cow Pox; and though this great physiologist received his statements doubtingly, he rather encouraged Jenner than otherwise to continue his inquiries. While he was in London, Captain Cook returned from his first voyage ; and the valuable Natural History specimens collected by Sir Joseph Banks were, in a great measure, arranged by Jenner, and with so much success, that he was offered the appointment of Naturalist to the next expedition On his return to practice in Berkeley, he continued his devotion to Natural History, and accumulated specimens enough to form a considerable museum ; and his biographer, Dr Baron, writes that "he wished from his earliest years to show how much information and amusement lie scattered around us, how bountifully the sublimest sources of gratification are supplied, and how desirable it is that all should be taught to taste them,"—sentiments which every naturalist will cordially echo. Even thus early he had acquired a distinguished reputation, not only in his profession, but also for his general scientific knowledge, as well as for the kind benevolence of his nature, and his general high character as a gentleman.[1]

[1] His researches in Natural History were of the most varied description, embracing such subjects as the habits of the cuckoo, bats, hedgehogs, eels ; the breeding of toads, salmon spawn, effects of frost on vegetables, fossils, the migration of birds, and many others. His old master Hunter kept him constantly employed collecting all sorts of objects for him : on

About this period he was a member of two local medical societies, at which he was a frequent contributor of valuable original papers, and he repeatedly urged his fellow members to enquire into the truth of the rumour about Cow Pox; but he could not persuade them that it was anything more than a groundless fancy of ignorant people. He nevertheless recurred to it so persistently, that at last they threatened to expel him if he continued to annoy them with such an unprofitable subject. Somewhere about this time he contributed a paper to the Royal Society, which was published in its transactions, on the habit of the cuckoo of depositing its eggs in the nest of another bird; and it is a curious fact that when he was subsequently about to publish his first paper on the Cow Pow, some friends endeavoured to dissuade him, on the ground that it would injure his reputation as a scientific man, which this paper on the cuckoo had secured to him.

He obtained, in 1792, the degree of Doctor of Physic from the University of St Andrews.

Being often engaged, like others, in inoculating patients with Small Pox, he now and again met with persons who could not be infected, and found in this circumstance (about 1775) some corroboration of his opinions, for, on enquiry, he frequently ascertained the history of a previous attack of Cow Pox. The course of his researches was by no means smooth. One of the first stumbling blocks was the not unfrequent occurrence of alleged cases of Small Pox after Cow Pox, which his opponents, as a matter of course, diligently collected. This led him to make a careful observation of the eruptions on the cow's udder, which ended in satisfying him that these were various, and that, although several of them would infect the human subject, producing local and other symptoms which were deceptive, there was only one form, the true Cow

one occasion, for instance, writing to him to get him, for love or money, a porpoise. Although so devoted to science, he was at the same time full of humour, and was also a poet and a musician, both as a singer and a performer on the violin and flute.

Pox, which would protect against Small-Pox. But a more formidable difficulty cropped up, and for a time his ardour was much damped. This was that even after undoubted true Cow Pox, a case of Small-Pox from time to time presented itself. However this also was satisfactorily explained, although, doubtless, not until after long and anxious consideration. The explanation was discovered by Jenner to lie in two circumstances, one affecting the matter employed, and the other affecting the recipient: the former was that only at a very limited period of the development of the Cow Pox vesicle was the matter truly protective; and the latter, that the subject to be vaccinated must be in good health, otherwise the normal course of the implanted disease was apt to be disturbed, and its protective power correspondingly impaired, and he especially insisted that the presence of certain eruptions was a very unfavourable condition.

In June 1798, Jenner published his first paper, entitled, "An Enquiry into the Causes and Effects of the Variolæ Vaccinæ, a Disease discovered in some of the Western Counties of England, particularly Gloucestershire, and known by the name of the Cow Pox." The date of this publication is a proof of Jenner's great caution, for it was not given to the public till after thirty years of patient observation and deep reflection, and almost every possible trial; and every one must be struck with admiration at the rigid scientific precision with which he conducted and verified his researches.

Jenner enters on his subject with the statement that man's deviation from his natural state is a prolific source of disease, and that his familiarity with various domestic animals further exposes him to infection with some diseases peculiar to them; then referring to the affection of horses popularly known as the "Grease," in which pustules appear about the heels of the animal, and which is communicable to man, he remarks upon the strong resemblance to Small-Pox, which this disease presents when it manifests itself in the human subject, and puts forward, al-

though doubtingly, the conjecture that Small-Pox may possibly have had its origin in some such manner. He was of opinion that, at all events, Cow Pox owed its origin to infection from the heels of the horse, and in this way:—It was the custom in that part of the country for the men-servants, as well as the dairy-maids, to milk the cows, and the infection was conveyed, by the hands of the former, from the horses' heels to the cow. One or more dairy-maids next became infected from the cow, and the disease was thus soon spread through the dairy. Since Jenner's time, it has been ascertained that his experience had not been such as to reveal to him the whole truth as to the origin of Cow Pox, for it is now known that Cow Pox may originate quite independently of the horse, and also that true Equinia, the disease of the horse which can produce Cow Pox, is not identical with Grease, although it frequently co-exists with it.

Jenner then goes on to detail a series of cases in proof of the absolute truth of the popular belief. His first case is this: Joseph Merrit, under gardener to the Earl of Berkeley, when servant with a farmer in 1770, attended horses with sore heels, and as he was employed also in milking the cows, these became affected with Cow Pox. Soon thereafter pustules appeared on his hands, and he became so ill as to be disabled from work. No new cow had been recently brought to the dairy by which infection could have been introduced, and no other servant was suffering from Cow Pox. During a general inoculation for Small-Pox in 1795, that is twenty-five years after he had had Cow Pox, repeated attempts to inoculate him failed, and when his family had Small-Pox, one of whom had a very severe attack, although living in the house with them, he remained well. He had never had Small-Pox. Jenner's investigations were greatly facilitated, he says, by their being conducted among a sparse country population, because the history of patients as to a previous attack of Small-Pox was thus very easily traced.

The second case is that of Sarah Portlock, who nursed one of her children ill of Small-Pox, and was, besides, twice inoculated on both arms without catching the disease. She had had Cow Pox twenty-seven years previously. Jenner purposely selected cases in which a long interval of time had elapsed, in order to show that the protective power was not thus destroyed.

Case III. — John Phillips had Cow Pox when nine years of age. At the age of sixty-two, Jenner inoculated him with Small-Pox, being careful to select matter in its most active state. Considerable local effects followed; but on the fifth day these began to disappear, and a few days later passed away without any effect on the system resulting.

Case IV. — Mary Barge, who had had Cow Pox thirty-one years before, was inoculated, but only with results similar to the last.

The next six cases present features closely resembling the four just given.

Case XI. — W. Stinchcomb had Cow Pox in 1782, and ten years later was inoculated with Small-Pox without effect. Of a numerous party inoculated at the same time, some suffered more violently than usual, and he purposely associated with them, but could not catch the disease.

Case XII. — The paupers of Tortworth were inoculated by Henry Jenner in 1795. Eight of them had had Cow Pox, and all of these escaped infection.

Case XIII. exhibits the protective power of matter from Grease. T. Pearce, six years after having suffered from this disease, was repeatedly inoculated with Small-Pox, and was, besides, exposed to infection from patients, but remained well. The next case proves the same fact, and Jenner remarks that the well-known observation that farriers frequently resisted inoculation was thus explained.

Case XV. is given to show that the protective power of Grease was not to be relied on till the virus had been modified by transmission through the cow, being that of a man who, twenty years after a severe attack

of the disease caught from the horse, had Small-Pox, which, however, was in a very mild form.[1]

Case XVII. is a very important one, being Jenner's first experiment with lymph not taken direct from the cow. Using lymph from a Cow Pox sore on a human subject, he vaccinated successfully on 14th May 1796, a healthy boy named Phipps, about eight years old. On the following 1st July he inoculated this boy with matter taken direct from a pustule on the body of a Small-Pox patient. "Several slight punctures and incisions were made on both his arms, and the matter was carefully inserted, but no disease followed." Several months afterwards a second attempt to inoculate him likewise failed. Jenner had thus made a great step in advance, having by this experiment proved that the virus lost none of its power by transmission through at least one human subject. Baron, in his biography, states that Jenner, after this event, writes to his friend Gardner full of joy at his success, saying that Gardner would be gratified to hear that he had at length accomplished what he had been so long waiting for—the passing of the virus from one human body to another, and he goes on to say: "But now listen to the most delightful part of my story. The boy has since been inoculated for the Small-Pox, which, as I ventured to predict, produced no effect. I shall now pursue my experiments with redoubled ardour."[2] This was indeed a new discovery, and especially when considered along with the series of cases next to be referred to, it was a most important one, the honour of which would appear to be exclusively due to Jenner, and which established the principle upon which Vaccination has been since practised—namely, the transmission of the virus successively from one human subject to another, without recurring to its original source in the cow. Many years afterwards, Phipps being in poverty, Jenner, at his own ex-

[1] Jenner, however, afterwards abandoned this idea; and it may be stated here that the parent stock of the lymph used in India for Vaccination was equine. (Seaton, "Handbook of Vacc.," p. 157.)

[2] After the introduction of Vaccination into Germany, this date (14th May) was celebrated in Berlin as an annual festival.

pense, built a cottage for him, in which he might spend the remainder of his life in comfort. Jenner has left a record of the state of his feelings as his enquiry proceeded: "While the vaccine discovery was progressive," he says, "the joy I felt at the prospect before me of being the instrument destined to take away from the world one of its greatest calamities, blended with the fond hope of enjoying independence and domestic peace and happiness, was often so excessive that, in pursuing my favourite subject among the meadows, I have sometimes found myself in a state of reverie. It is pleasant to me to recollect that these reflections always ended in devout acknowledgments to that Being from whom this and all other mercies flow."

Recurring to Jenner's paper, the following most interesting series of observations is recorded :—

W. Summers, aged 5½ years, was vaccinated from the cow effectively. From him W. Pead was vaccinated on March 28th. On April 5th, several children and adults were vaccinated successfully from Pead. From one of these, on April 12th, were vaccinated four children, three of them successfully. And lastly, from one of these, J. Barge, aged seven, was successfully vaccinated. On this last patient, inoculation of Small-Pox was afterwards tried, but failed; and in order to make sure that the Small-Pox matter was not at fault, another portion of the same matter was used to inoculate a person not protected by Vaccination, with the result of communicating Small-Pox. Jenner remarks on this new observation: "These experiments afforded me much satisfaction; they proved that the matter, in passing from one human subject to another through five gradations, lost none of its original properties."

This treatise met with much opposition and even ridicule. With reference to the opposition which he encountered, Jenner remarks, in a letter to his friend Gardner: "Brickbats, and hostile weapons of every sort, are flying thick around me; but with a little aid, a few friendly opiates seasonably administered, they

will do me no injury." And in another letter he writes: "Though my bark will, with flying colours, reach the shore at last, yet it is now in a storm. I am beset on all sides with snarling fellows, and so ignorant withal, that they know no more of the disease they write about than the animals which generate it." His conviction of the truth of his opinions never wavered, and in order to explain some of the fallacies which were at the foundation of adverse criticism, he published another treatise, in April 1799, dwelling more particularly on the possible sources of spurious Cow Pox, and strongly urging his critics to suspend their judgment as to alleged cases of Small-Pox after Vaccination, until the distinction between true and spurious forms of Cow Pox was better known; and he also, with the extreme caution which characterised him, recommends that at this early stage of his enquiry, when it had not been clearly ascertained at what stage of the Cow Pox the virus might begin to lose its power, persons vaccinated should, for greater security, undergo in addition inoculation with Small-Pox. He was now receiving confirmatory evidence from professional friends. Mr Fry, Surgeon, wrote him that in 1797 he had inoculated with Small-Pox one thousand four hundred and seventy-five persons, and that among them there were many (the exact number he could not give, but was certain thirty was within the mark) who had had Cow Pox, and that not one of these could be infected, though the attempt was made four, five, and even six times.

Jenner concludes his second paper as follows:—

"The very general investigation that is now taking place, chiefly through inoculation (and I again repeat my earnest hope that it may be conducted with that calmness and moderation which should ever accompany a philosophical research), must soon place the Vaccine disease in its just point of view. The result of all my trials with the virus on the human subject has been uniform. In every instance, the patient who has felt its influence has completely lost the susceptibility for the variolous contagion: and as these instances have now become numerous, I conceive that,

joined to the observations in the former part of this paper, they sufficiently preclude me from the necessity of entering into controversies with those who have circulated reports adverse to my assertions, on no other evidence than what has been casually collected."

About this date Dr Woodville, in London, made experiments which had a very prejudicial effect, these having been performed in the Small Pox Hospital, where the patients were thus exposed at the same time to Small Pox infection; and not only so, but many of them were actually inoculated with Small Pox on the third and fifth day after being vaccinated. The results were what might have been anticipated, the patients presenting a general eruption, sometimes as many as two or three hundred pustules; and to add to the evil effect of this mistaken practice, the matter taken from these patients was distributed as pure Vaccine not only over many parts of England, but also of the Continent. Jenner, in writing on this unfortunate occurrence to a friend, says that he could not divest himself of the suspicion that the London Cow Pox was somehow or other compounded with Small Pox.

In 1800 he published a third Paper, in which he states that he finds that his discovery has been warmly adopted abroad, where it has afforded the greatest satisfaction; and that "the feeble efforts of a few individuals to depreciate the new practice are sinking fast into contempt beneath the immense mass of evidence which has risen up in support of it." As part of this evidence, he was now able to assert that "upwards of 6000 persons have now been inoculated with the virus of Cow Pox; *and the far greater part of them have since been inoculated with that of Small-Pox, and exposed to its infection in every rational way that could be devised, without effect.*" He gives, in addition, the evidence of Dr Marshal, *who had inoculated with Small-Pox 211 vaccinated persons, but without success in a single case.* The conclusion of this third Paper is in these truly philosophical words:—

"The scepticism that appeared, even among the most enlightened medical men, when my sentiments on the important subject of the Cow Pox were first promulgated, was highly laudable. To have admitted the truth of a doctrine, at once so novel, and so unlike anything that ever had appeared in the annals of medicine, without the test of the most rigid scrutiny, would have bordered upon temerity. But now, when that scrutiny has taken place, not only among ourselves, but in the first professional circles in Europe; and when it has been uniformly found in such abundant instances that the human frame, when once it has felt the influence of the genuine Cow Pox in the way that has been described, is never afterwards at any period of its existence assailable by the Small-Pox;[1] may I not, with perfect confidence, congratulate my country and society at large on their beholding, in the mild form of the Cow Pox, an antidote that is capable of extirpating from the earth a disease which is every hour devouring its victims,—a disease that has ever been considered as the severest scourge of the human race?"

Jenner now began to reap the reward of his perseverance, and his triumphant vindication of the truth of his opinions, in the honour and renown which was freely accorded to him from the highest authorities in every country. On the 7th March 1800 he was presented to the king by Lord Berkeley. In 1802 Parliament awarded him, although not without strong and ungenerous opposition, a sum of £10,000,—a sum which by very many was considered quite inadequate. However, in 1806, some influential friends succeeded in bringing his claims again before Parliament, representing strongly the great loss of money which he had incurred in the course of his inquiry, and the noble and disinterested unselfishness which he had displayed in throwing the fruits of his labour open to the world, without taking any precaution to reimburse himself; and he was ultimately awarded a further grant of £20,000. In 1803 he took his seat as President of the Royal Jennerian Society, which was founded to propagate the practice of Vaccination.

Notwithstanding all this, he was the object of much

[1] See page 35, under REVACCINATION.

malevolence; and he felt so keenly at times the attacks of his detractors, as to be driven to show that he had his share of the weakness of other mortals, in expressing himself somewhat more strongly than was warranted, considering the high marks of esteem he was receiviug from those most competent to judge. In writing to a friend about the year 1804, after pointing with triumph to the enthusiastic reception his discovery had met with abroad, and to the thousands who were being vaccinated in every clime, he goes on to say, "I could march you round the globe, and wherever you rested your eye, you should see scenes like these. There I have honour; here I have none." He refers humorously to the great labour he is undergoing, saying, "On an average I am at least six hours daily with my pen in my hand bending over writing paper, till I am grown as crooked as a cow's horn, and tawny as whey butter; and you want to make me as mad as a bull; but it won't do, Mr D., so good-night to you." Besides being, as he used to say, "Vaccine Clerk to the World," he used to vaccinate all who chose to come, and would sometimes have, it is said, nearly 300 at his door at once. The opposition assumed very absurd forms. An eminent American physician declared that the practice of Vaccination was "too beastly and indelicate for polished society." A German divine proved, to his own satisfaction, from the Scriptures and the Fathers of the Church, that Vaccine was nothing less than Antichrist. And prints were actually published in this country, exhibiting the human face in process of transformation, and assuming the appearance of the visage of the cow.

An incident which well exhibits Jenner's unostentatious and contented spirit is worthy of mention. He was solicited to settle in London, where he was assured he would soon enjoy a most lucrative practice; but he writes to a friend:—"It is very clear from your representation that there is now an opening in town for any physician whose reputation stood fair in the public eye. But here, my dear friend, here is

the rub. Shall I, who, even in the morning of my life, sought the lowly and sequestered paths of life, —the valley, and not the mountain,—shall I, now my evening is fast approaching, hold myself up as an object for fortune and for fame? Admitting it as a certainty that I obtain both, what stock should I add to my little fund of happiness?" And further on, he adds, "And as for fame, what is it? A gilded butt, for ever pierced with the arrows of malignancy."[1]

On 6th August 1820 he had an alarming illness, being suddenly seized in his garden with an attack of faintness and giddiness so severe as to cause him to fall, but from this illness he recovered, and appeared to regain his health completely, engaging again deeply in his Vaccination correspondence. On 25th January 1823 he was struck down by apoplexy, which proved fatal on the following day. Thus terminated, in the 74th year of his age, the life of this truly great man, one of the greatest benefactors of humanity which the world has ever known. On the back of a letter, bearing the post-mark Jan. 14, 1823, only twelve days before his death, were found his last words on Vaccination. "My opinion on Vaccination is precisely as it was when I first promulgated the discovery. It is not in the least strengthened by any event that has happened, for it could gain no strength : it is not in the least weakened ; for if the failures you speak of had not happened, the truth of my assertions respecting those coincidences which occasioned them would not have been made out."

Notwithstanding all opposition and ridicule, in which, it is melancholy to relate, our own country far excelled, the practice of Vaccination spread over the world in a

[1] Amongst the honours conferred upon him, both in his native country and from Europe and America, were degrees and diplomas from Universities and Colleges, and congratulatory addresses from municipal bodies ; a presentation of plate from "the nobility and gentry of the County of Gloucester" (1801); the Napoleon Medal (1804); a ring set in diamonds from the Dowager Empress of Russia ; a presentation of £3000 from Calcutta and its dependencies (1808) ; elected Corresponding Member of the National Institute of France (1808), and three years later to the still higher honour of Foreign Associate, &c., &c.

manner which has never before or since characterised any new discovery. After 1800, it spread in a few months over Europe, and to our colonies and America; and numerous publications on the subject appeared in almost all languages. A noteworthy example of zeal in a good cause was the despatch of an expedition, in 1803, by the king of Spain, on a voyage nearly round the world, which occupied close on three years, for the purpose of introducing Vaccination, not only into his own foreign possessions, but also those of other nations. Twenty-two children were taken on board, and at Acapulca twenty-six more, in order to keep up a supply of fresh lymph. These voyagers were everywhere warmly welcomed; and even the uncivilised Indians quickly learned to perform the operation, and diffused the practice among their tribes. Curiously enough, Dr Balmis, who was in charge, was the first to succeed in persuading the English in St Helena to adopt Vaccination, although they had previously received lymph from Jenner himself. To relate at length how Vaccination was spread would be tedious; but it deserves to be noted that even the Chinese, proverbially so contemptuous of any innovation from barbarians, eagerly adopted this one, a treatise on the subject in the Chinese language being actually published in 1805 or 1806 in Canton. Dr Baron writes that "in little more than six years after its promulgation, it was known in every clime."

Small-Pox Mortality before and after the Discovery of Vaccination.

Now much can be learned as to the powers of Vaccination by comparing the mortality from Small-Pox before, with that after Jenner's gift to the world. From the accumulated statistics available for this purpose a selection must suffice.

The Governments of Sweden and Denmark enforced Vaccination in 1803, and here is how the Small-Pox fatality stood in Copenhagen, taking successive periods of ten years before that date.

From 1752 to 1762 it was 2644.
„ 1762 „ 1772 „ 2116.
„ 1772 „ 1782 „ 2233.
„ 1782 „ 1792 „ 2785.

Now observe the change.

From 1802 to 1810 it was 158.
„ 1811 „ 1824 „ 0. [1]

In Sweden the number of deaths from Small-Pox in 1779 was 15,000, and in 1800 it was 12,000. After Vaccination was introduced there was a steady diminution till in 1822 the deaths were only 11, in 1823 there were 37, and during the next 8 years there was not one case.[2]

In the town of Anspach, in Bavaria, the Small-Pox deaths during 1797, '98, and '99 were above 500 annually, and in 1800 they were 1609; but in 1809, that is after Vaccination was adopted, taking the whole of Bavaria, with a population above 300,000, the deaths were only 4, and from that date till 1818, not one; and this proof is emphasised by the circumstance that in the neighbouring state of Würtemberg from 1814 to 1817 Small-Pox was epidemic.[3]

Vaccination was introduced into Vienna in 1799. In 1804 only two deaths from Small-Pox occurred in this city, and it is stated that for five years up to 1812 it had been free from Small-Pox; and that Milan at the same period had been free from it for eight years, although the disease had previously been worse in these cities than in London.[4]

In Berlin the average annual mortality from Small-Pox before 1802, when Vaccination was introduced, was 472, for the next 20 years the average annual number was 175, although several epidemics had occurred; but after the foundation of the Vaccine Establishment in 1812, the annual mortality fell to 50, after 1817 to 12, and for 1821 and 1822 only one each year.[5]

[1] Baron's "Life of Jenner," Vol. II., p. 253. [2] "Encycl. Britan."
[3] Baron, *op. cit.* [4] Baron, *op. cit.*, p. 265. [5] Baron, *op. cit.*

A commission appointed by the Royal Academy of Medicine of Paris, in 1825, reported that the great public establishments in France, into which no person was admitted without a certificate of either having had Small-Pox, or having been vaccinated, were never infected by this disease, although they were for the most part situated in the midst of contagion.[1]

To take an example from our own country, Mr Hart states that "the average fatality of Small-Pox in London was *more than forty times greater* during 67 years of the 17th and 18th centuries than it has been in the most recent 42 years of the 19th century, notwithstanding the remarkable epidemic of 1871."[2]

Vaccination and Revaccination are enforced in the army and navy, and very striking evidence is afforded by the statistics. Among the Dragoon Guards for 20 years (1817-36) with an aggregate strength of 44,611 men, and a total mortality of 627, only *three* deaths were from Small-Pox. Among the troops at Gibraltar during the same period, with an aggregate strength of 44,611 men, and a total mortality of 1291, only *one* death was from Small-Pox. In the West Indies, in spite of the prevalence of several epidemics during the period, the British or white troops, with an aggregate strength of 86,661, and a total mortality of 6803, had not one death from Small-Pox, and among the black troops, which numbered 40,934, there was not one case. In Malta, from 1818 to 1838 inclusive, the aggregate strength of the British troops being 40,826, only two deaths from Small-Pox occurred amongst them, a fact which derives more force, seeing that an epidemic raged all over the island in 1830, and again in 1838, destroying 1169 persons.[3]

In the army and navy as a whole, taking the average of the six years 1850-64, though two severe epidemics occurred during that period, the

[1] Baron, *op. cit.*, p. 278. [2] Hart, *op. cit.*, p. 35.
[3] Aitken, "Science and Pract. of Med.," 7th edit., pp. 479 and 480.

annual mortality from Small-Pox was among the soldiers somewhat less than 1 per 10,000, and among the sailors somewhat more than 2 per 10,000; presenting a striking contrast to the pre-vaccination period when Small-Pox was "one of the greatest embarrassments to the operations of armies."[1]

Two other marked examples may be quoted from Dr Seaton. "In the Royal Military Asylum there has been no fatal case of Small-Pox among the many thousand vaccinated children admitted since its institution in 1803; four deaths from Small-Pox there have been in the Asylum, but they were all in children who, being believed to have already had Small-Pox, had not been vaccinated. Among an annual average of 550 boys in Christ's Hospital there occurred, during the last half of last century, 31 deaths from Small-Pox; among an annual average of 800 boys there was, during the first half of this century, but one death from this cause—a death which occurred in the year 1820."[2]

In 1853 the first compulsory Vaccination Act was enacted in England, the effect of which was to reduce the Small-Pox mortality by a half. Thus, during the sixteen years prior to this date, exclusive of four (1843-46) where there is a break in the statistics, the annual mortality stood at 420 per million of inhabitants, while in the twenty-six years following it fell to 208.5 per million.[3] Another proof of the effect of this Act was a change in the incidence of the mortality as it affected children and adults; thus during the years 1848-52, 44 per cent. of all the deaths from Small-Pox occurred among children from one to five years of age, while during the years 1873 to 1877, the proportion was only 13 per cent. Children under a year old are not reckoned, because many die from Small-Pox before they have reached the usual age for Vaccination.

Next let us enquire how the mortality was appor-

[1] Seaton, *op. cit.*, p. 243. [2] *Op. cit.*, p. 246. [3] Hart, *op. cit.*, p. 37.

tioned when Small-Pox invaded a community partially protected by Vaccination. Dr Marson, gives details by M. Bosquet of observations during an epidemic in Marseilles in 1825. The population was 40,000, and he divides it into three classes, the Unprotected, the Variolated (that is protected by natural or inoculated Small-Pox), and the Vaccinated.

Relative Mortality among Vaccinated and Unvaccinated.

	Number of Persons.	Cases.	Deaths.	Proportion of Deaths.
Unprotected,	8000	4000	1000	1 in 4
Variolated,	2000	20	4	1 in 5
Vaccinated,	30,000	2000	20	1 in 100[1]

The same writer from general data gives the proportion of fatality as follows :—

Unprotected, . . .	1 in 4
Variolated, ...	1 in 25 to 1 in 75
Vaccinated, ...	1 in 330

From this, he observes, we learn that Vaccination confers a greater protection than Small-Pox itself, and he explains this by the fact that this disease so frequently leaves the system enfeebled or diseased, and thus an easy prey when attacked a second time. Very different is the case with Vaccination, "for no fact," he says, "is more firmly established than this, that Vaccination neither developes any latent malady nor engenders a predisposition to any particular disease."

Again, the statistics of four Italian cities give the following results :—

	Percentage of Mortality among Unvaccinated.	Vaccinated.
Genoa, . . .	66.08	14.24
Milan, . . .	50.90	16.39
Turin, . . .	44.31	10.79
Naples, . . .	43.10	12.90[2]

The clerk to the Metropolitan Asylums Board, London, states that in 15,171 cases the mortality among the Unvaccinated was 44.4 per cent., while among the Vaccinated it was only 8.8 per cent.

[1] "Encycl. Brit." [2] "Brit. and For. Med. Chir. Rev., 1873," p. 253.

The statistics of the same Board give the following results among children under five years of age. From the middle of 1876 to the end of 1878, 1075 patients of this age were admitted to the Hospital; of these there were—

Unvaccinated, 837, with a mortality of 56.1 per cent.
Vaccinated, 238, „ „ 5.4 „ [1]

Seaton[2] gives a very instructive table founded on an enquiry by Dr Paine, during an epidemic in Cardiff (1857), which in a most striking manner exhibits the liability of children to catch Small-Pox, and the protective power of Vaccination. Four streets were especially affected, and the children living in these streets numbered 711. The disease attacked them in the following proportions:—

	Number of Children.	Cases of Small-Pox.	Proportion per cent. Infected.
Protected by Small-Pox,	33	0	0
„ Vaccination	608	18	2.96
Unprotected	70	70	100.

A volume might be filled with such statistics, but they all tell the same marvellous story.

Degree of Protection varies with quality of Vaccination.

But there are good Vaccinations and bad Vaccinations, and just in proportion as the Vaccination has been good or bad, is the protection which the vaccinated person receives. A good Vaccination mark, or cicatrix as it is termed, is known by certain appearances; it is slightly depressed, somewhat paler than the surrounding skin, and "foveated," that is, presenting little depressions or pits scattered over its surface. This last characteristic is very important; a bad Vaccination will leave a cicatrix, often a very obvious one, but it will not show well the "foveation." When bad Vaccination or bad matter is spoken of, it is not in the sense that it contains the germs of some disease-process other than itself, but that it is imper-

[1] Hart, *op. cit.*, p. 39. [2] "Hand-book of Vacc.," p. 236.

fect vaccine, that is, feeble in action or producing a vaccine process having an irregular course, and which will only afford a protection more or less incomplete. It has been supposed that lymph, by long transmission through the human subject has become deteriorated, but of this there is no evidence; on the contrary, Drs Marson and Steele both state that with lymph first supplied by Jenner himself, about fifty years before, they produced vesicles in all respects as good as the first.[1] But although this is true, lymph will very readily deteriorate in a vaccinator's practice, unless he is careful only to vaccinate from perfect vesicles. This careful selection of lymph is a most important thing. It is probable that from the use of impotent lymph result many of the failures which lead to a child being certified as insusceptible. This condition is exceedingly rare. For example, Marson states that an expert vaccinator, using all proper precautions, should not fail above once in 150 times; but more than this, Mr Sheppard at Bristol had above 2000 vaccinations without one failure, and Marson himself had a similar experience;[2] and Seaton states further, that every year many children are brought to the Establishment on whom Vaccination is said to have failed on from two or three up to even six or seven trials, and that he does not know of one failure in these, and almost always there was success on the first trial.[3] But still more, at the Blackfriars Station there was out of 9000 only one case which failed on a second trial.[4]

It is easy to see the disastrous result of this false belief in insusceptibility, because the person remains satisfied, while in reality utterly unprotected against Small-Pox.

But not only should the mark present the proper characteristics, but the area of the cicatrix should be of sufficient extent; this may be all in one mark, or it may consist of two, three, or more marks, but experience has taught that the total area must be not less

[1] Seaton, *op. cit.*, p. 180.
[2] *Op. cit.*, p. 170.
[3] *Op. cit.*, p. 160.
[4] *Op. cit.*, p. 175.

than half a square inch. The rule of the National Vaccine Establishment is to make at least four good marks, more rather than fewer, or to produce equivalent local results. Many are inclined to believe that one good mark is sufficient evidence that the system has been thoroughly affected, but that this is an error is incontestably proved by accumulated observations.

Now, with regard to the statistics which have been quoted, it is particularly to be observed that they include all kinds of Vaccination, good, bad, and indifferent; but if only the good Vaccinations are reckoned, the result is immensely more favourable. Marson gives the average mortality after Vaccination of any quality as 5.24 per cent., but he says, "when Vaccination is known to have been perfectly performed, *as shewn by the cicatrices*, the mortality is uniformly found to be reduced to *less than half of one per cent.*[1] Seaton[2] quotes Marson's table founded on nearly 5000 cases of post-vaccinal Small-Pox, occuring in an experience of twenty years (1836-55), which shews very clearly the influence of the number of marks, and this even without having regard to their quality.

With one	cicatrix	the mortality was	7.73	per cent.
„ two	cicatrices	„	4.70	„
„ three	„	„	1.95	„
„ four or more	„	„	.55	„

Dividing the cases into the two classes—those with good marks and those with bad marks—the mortality stands among the former 2.52, and among the latter 8.82.

Again, Mr Hart states[3] that during the epidemic, 1871-72, there were admitted to the Stockwell and Homerton Hospitals 2382 patients with vaccination marks, and that of these 516 had bad marks, and suffered a mortality of *25 per cent.*, while 1866 patients had good marks, and suffered a mortality of *3.9 per cent.* And how were the deaths apportioned among

[1] Aitken, *op. cit.*, p. 483. [2] *Op. cit.*, p. 216. [3] *Op. cit.*, p. 44.

those 1866 with good marks, with reference to the number of these?

Cases.	No. of Marks.	Deaths.	Percentage of Deaths.
1306	1 or 2	60	4.5
560	3 or more	10	1.8

To illustrate this point still further, one more table may be given. It shows the results of a thousand cases in the Homerton Hospital during the same epidemic, and includes, therefore, a portion of the cases which have just been referred to, but Dr Collie, the Superintendent, has carried out the analysis more particularly.

Degree of Vaccination.	Under 15 Years of Age.				Above 15 Years of Age.			
	Total.	Recov.	Died.	Deaths per Cent.	Total.	Recov.	Died.	Deaths per Cent.
Unvaccinated,	208	131	77	37.0	122	76	46	47.7
One or more *bad* Marks, . . .	45	42	3	6.5	104	89	15	14.4
One or more indifferent Marks,	12	12	0	0	75	66	9	12.0
	265				301			
1 good vac. mark,	61	61	0	0	101	93	8	7.9
2 ,, ,,	29	29	0	0	104	99	5	4.8
3 ,, ,,	35	35	0	0	39	39	0	0
4 ,, ,,	17	17	0	0	32	32	0	0
5 ,, ,,	2	2	0	0	1	1	0	0
6 ,, ,,	2	2	0	0	11	11	0	0
	411	331	80		589	506	83	

Here, it will be observed, that under fifteen years of age there is no death in any well vaccinated patient, notwithstanding fewness of marks; but after fifteen the difference in protection begins to tell, and there is an occasional death until the standard of three or more good marks is reached, with which not only is there a great fall in the number of cases, but not one death occurs.

There is no gainsaying such evidence as this, and it is in the highest degree worthy of the consideration of loving mothers, by whom it is a very constant

request to the doctor "to make just one mark;" and tender solicitation for their little ones is highly praiseworthy. But even though the multiplying of the marks did slightly increase the present inconvenience, which is very doubtful, true regard for the child's future well-being must consist in securing as perfect a protection against Small Pox as is possible.

Revaccination.

And now the question of Revaccination must be shortly considered. Jenner, as has been seen, appears to have at first believed that a good Vaccination was an absolute protection for life; but whether or not he meant this literally, he did not continue to maintain it, for he has distinctly stated, "duly and efficiently performed, it will protect the constitution from subsequent attacks of Small Pox as much as that disease itself will. I never expected it would do more, and it will not, I believe, do less."[1] Subsequent experience, however, has shown that the protective power does become impaired with the growth of the body. About the year 1829, on account of the not infrequent occurrence of Small Pox, although modified, in vaccinated persons, the practice of Revaccination was commenced in Germany and Prussia, these countries thus making a distinct advance on that of the Vaccine discovery. To expect an absolute life-long protection, was to expect too much. Not one of the diseases which, as a rule protect against a second attack, possess this power, not even Small Pox itself. The Provincial Medical and Surgical Association, in 1839, collected two hundred and thirty-nine instances of a second attack of Small Pox, and the Epidemiological Society, in 1851, above two hundred. A notable case was that of Louis XV. of France, who had this disease in his fifteenth year, but died of a second attack at the age of sixty-four. There need be no surprise, therefore, if Small Pox should occasionally occur after an efficient vaccination or even revaccination.

Nevertheless, Revaccination affords almost absolute

[1] Baron, *op. cit.*, Vol. II., p. 135.

protection, as will be evident from the following facts. Among 14,800 cases of Small-Pox treated in the Hospitals of the Metropolitan Asylums Board during the terrible epidemic of 1871-72, only 4 occurred in persons who had been properly revaccinated. And among 15,171 cases treated in these hospitals from the commencement of the epidemic in 1876 till October 1879, "No case of Small Pox came within the cognizance of any of the medical superintendents of any person who had been efficiently vaccinated and successfully revaccinated."[1] It is the practice in the London Small-Pox Hospital invariably to vaccinate all the nurses and other servants on their entering on service, this, of course, being mostly revaccination; and although all the nurses are constantly under full exposure to this most potent contagion, and the other servants to a less degree, yet Dr. Marson, during forty-one years of experience as medical superintendent, never knew one of these to be attacked by Small Pox. Could any evidence be stronger?

A small contribution may be added from the writer's own experience, which, though dealing with much smaller figures, is of value so far as it goes. During the epidemic in Dundee in 1871-72, all the officials, nurses, and servants in the Royal Infirmary, numbering in all about forty, were revaccinated, except five or six who did not submit to the operation. The medical officers and Small Pox nurses were daily exposed to the full force of the contagion in over-crowded wards, yet not one of these, nor of the other nurses and servants who had been revaccinated, caught the disease, except one servant, who had a slight indisposition, which the appearance of four or five pustules showed to be Small Pox. In striking contrast to this, three of the five or six not revaccinated were attacked by the disease in a severe form, and this, although they were not in immediate intercourse with the Small Pox cases. In the Western Poor House, Dundee, all the officials and inmates who had not had Small Pox were revaccinated, except one young woman, attendant on

[1] Hart, *op. cit.*, p. 43.

the lunatics, who, forsooth, did not believe in Vaccination. She was the only case of Small Pox in the establishment.[1]

There can be no doubt, therefore, that every person, on approaching adult life, if not sooner, and at all events in the presence of a threatened epidemic, should be revaccinated. With this means within one's power, no one need fear, although in the midst of an epidemic.

[1] In the face of the mass of evidence which exists, of which only a small portion has been advanced in this paper, demonstrating to a certainty the efficacy of Revaccination, it is melancholy to behold the severity of the present epidemic in London. There are about one thousand Small-Pox cases in hospital, and no room for more, although hundreds are requiring admission. The attempts of the authorities to provide additional accommodation are arrested by the fear of the people to have fever hospitals planted in their midst. Every one of these cases thus left unprovided for is acting as a fresh centre from which infection is spreading; hundreds of lives are being unnecessarily sacrificed, and a great and unnecessary expenditure of money is going on from day to day. Although it may be impossible, as yet, to make general Revaccination compulsory, it might be practicable to confer upon sanitary authorities the power to enforce, under such circumstances, the Revaccination without delay of every uninfected inmate (unless already revaccinated) of a house in which the disease has appeared. It is no over-confidence to say that, were this done, the epidemic would soon show signs of diminution. An experience recently reported in the *Times*, and in the *Lancet* (April 23), supplies evidence as if it had been a planned experiment. The conditions are—a ship bound from London to New York, a case of Small-Pox on board, and the surgeon revaccinating as many of the crew as his supply of lymph will suffice for. What is the result? The revaccinated escape, while of their less fortunate shipmates, the greater number catch the disease, and three die. Surely if Revaccination secure safety under such conditions as exist on board ship, it is worth trying when Small-Pox appears in a household.

The *British Medical Journal* for May 7th contains still another very remarkable corroboration of what has been said. It is furnished in a report by Dr Walter Lewis, Chief Medical Officer of the General Post Office, which report "relates to an average number of 10,504 persons permanently employed in the postal service in London, all of whom have been required to undergo Revaccination on admission to the service, unless that operation had been performed within seven years previously. Among those persons, during the ten years 1870-79, there was not a single fatal case of Small-Pox, and in only ten instances were there non-fatal attacks, all of which were of a very slight character. In the telegraph department, where the enforcement of revaccination has not been carried out with quite the same completeness, twelve cases occurred in the same period among a staff averaging 1458 in number. Eight of these attacks were of persons who had not been revaccinated, and one proved fatal. The remaining four were of revaccinated persons, who all perfectly recovered without pitting. This experience goes to confirm the belief that revaccinated persons enjoy absolute immunity from severe attacks of Small-Pox, and that their risk of catching the disease at all, even in the most modified form, is infinitesimal."

Dr Seaton considers 15 as the best age for renewal of the protection ; and his opinion is undoubtedly correct that Revaccination should be as systematic as the vaccination of infants. He also considers it quite unnecessary to repeat Revaccination. If this practice were everywhere fully observed, all the facts of experience go to prove that Jenner's fond ambition would be realised, in the extirpation of Small-Pox from the face of the earth.

How is Cow Pox Protective against Small Pox.

Now, how does it happen that this small operation protects from Small-Pox? We know that certain diseases, as a rule, attack a person only once in his lifetime. But, it may be said, being vaccinated is not the same thing as having Small-Pox. Jenner believed that it was; that Cow Pox was just Small-Pox, modified in some way by transmission through the constitution of the cow; and subsequent investigations confirm his belief. A most painstaking and long-continued investigation of the whole subject of Cow-Pox, and conducted in the most able manner, was made, in 1838-39, by Mr Robert Ceely, surgeon in Aylesbury, (and published in the Transactions of the Provincial Medical and Surgical Association for 1840,) in which he corroborated, in the most striking manner, Jenner's statements, especially as to the many forms of eruptive disease in the cow, and the liability to mistake spurious forms for the genuine Cow Pox ; and in the course of his inquiry he succeeded in producing the Vaccine disease in the cow by inoculation with Small-Pox matter. Dr Sonderland, of Barmen, had published, in 1830, that he had been successful in infecting the cow, by covering it with the blankets from the bed of a patient who had died of Small-Pox, and hanging other infected clothes round the animal ; and that the inoculation of the human subject with the lymph so generated in the cow produced the genuine vaccine vesicle. Ceely repeated this experiment, but his attempt was a failure. On making the experiment,

however, of inoculating a young stirk with Small-Pox matter, he succeeded in infecting it ; and subsequent vaccination of the bovine patient produced no effect, although the same lymph was effective on two other animals vaccinated at the same time. With lymph from the pustules on this stirk he vaccinated, not without fear and hesitation, five children, in four of whom the operation was successful in producing true vaccine. With the lymph from another animal inoculated with Small-Pox he also vaccinated the human subject with varying degrees of effect, "but when successful, produced perfect vaccine vesicles." Lymph taken from those children was afterwards extensively employed in vaccination with perfect success. Mr Badcock, of Brighton, has vaccinated with entire success upwards of 20,000 persons with lymph taken from cows which had been inoculated with Small-Pox ;[1] and Dr Thiele, of Kasan, succeeded in variolating the cow, and with lymph from this source vaccinated above 3000 persons. It has been alleged that the illness produced in this manner is simply mild Small-Pox, a statement which is refuted by the fact that it never spreads by infection like natural or inoculated Small-Pox, the infectiousness of which is present even in the mildest case.

Professor Aitken[2] quotes from Mr Ceely a very interesting proof of the infection of cows by the effluvia of cases of Small-Pox in the human subject. It happened at the village of Oakley, about sixteen miles from Aylesbury, during an epidemic of Small-Pox.

"Two cottages, in which three persons resided during their illness, were situated one on each of two sides of a long narrow meadow, comprising scarcely two acres of pasture land. One of these three patients, though thickly covered with pustules of Small-Pox, was not confined to her bed after the full development of the eruption, but frequently crossed the meadow to visit the other patients, a woman and a child, the former of whom was in great danger from the confluent malignant form of the disease, and died. She was buried the same evening, according to custom; but the intercourse between

[1] Hart, *op. cit.*, p. 18. [2] *Op. cit.*, p. 469.

the cottages across the meadow was still continued. On the day following death the wearing apparel of the deceased, and the bed-clothes and bedding of both patients, were exposed for purification on the hedges bounding the meadow; the chaff of the child's bed was thrown into the ditch; and the flock of the deceased woman's bed was strewed about on the grass over the meadow, where it was exposed and turned every night, and for several hours during the day. This purification of the clothes continued for eleven days. At that time eight milch cows and two young heifers (stirks) were turned into this meadow to graze. They entered it every morning for this purpose, and were driven from it every afternoon. Whenever the cows quitted the meadow, the infected articles were again exposed on the hedges, and the flock of the bed was spread out on the grass, and repeatedly turned. These things remained till the morning, when the cows were readmitted, and the contaminated articles were supposed to be withdrawn. It appears, however, that the removal of the infected articles was not always accomplished so punctually as had been enjoined, so that, on one occasion at least, the cows were seen in the midst of them, licking the flock of the bed which lay on the grass. These cows were in perfect health when first put out to graze; but in twelve or fourteen days *five* (out of the eight) milch cows appeared to have heat and tenderness of the teats."

The symptoms which successively appeared need not be detailed. The local effects manifested themselves in papules, passing into vesicles, then scabs, and at the same time the animals suffered severely constitutionally, with rapid loss of flesh. The proprietor of the animals was convinced that they had been infected by the Small-Pox contagion; and most people will probably agree with him. So many of the cattle taking ill at the same time pointed to one common cause. They were in perfect health before they were put into the meadow; and no vaccine variola was known to be at the time in the neighbourhood.

Many other observations and experiments have been made, both in this country and abroad, which afford the strongest evidence that Cow Pox is Small-Pox modified by transmission through the constitution of the cow.

After all these irresistible proofs of the marvellous power of Vaccination to prevent Small-Pox, it may well be asked how it is that this terrible pestilence still prevails, and ever and anon bursts forth in violent epidemics, slaying its thousands of victims. The reply is—INEFFICIENT VACCINATION: firstly, in that multitudes, especially in large over-crowded cities, still remain unvaccinated, the number of this unprotected population being largely contributed to by the late period of infancy which the law allows within which the operation must be performed:[1] secondly, in that vast numbers, supposed to have been properly vaccinated, have merely passed through a form, in some cases having received ineffective lymph, in other cases the patient not having been in a state of health properly to develope the vaccine process, and in others, although the lymph may have been unobjectionable, yet they have received only one or perhaps two insignificant marks: and thirdly, the neglect of Revaccination.

[1] In the *Lancet* of April 2, 1881, Dr Yarrow states that he has vaccinated five or six hundred children under seven days old, and without any bad result.